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*THE GROWTH OF THE ALASKAN FUR SEAL HERD BETWEEN
1912 AND 1917*

By G. H. PARKER

UNITED STATES SEAL INVESTIGATION, 1914

Read before the Academy, April 23, 1918

The apprehension with which the condition of the Alaskan fur seal herd was viewed some half decade ago has disappeared in consequence of the steady growth of the herd. Few animals have been more closely watched and counted from year to year than the Alaskan fur seals and their remarkable habits of breeding exclusively on the Pribilof Islands and of assembling there each summer in one immense complex family render these counts of no small biological interest. It is probable that in late July and early August of each year every living Alaskan fur seal (*Callorhinus alascanus*) is either on one of the Pribilof Islands or in the immediately adjacent sea. Thus an annual complete rendezvous of this species takes place in an almost unique way, and this rendezvous gives opportunity for a census of the fur seal such as is possible in scarcely any other undomesticated animal.

Table I exhibits in several particulars the numerical conditions of the herd from the summer of 1912, when detailed counting was begun, to that of 1917. The numbers in this table are taken from the successive reports on the state of the herd as given out in the publications of the United States Bureau of Fisheries (Osgood, Preble, and Parker, 1915; Bowers and Allen, 1917; Smith, 1917; *Fisheries Service Bulletin*, No. 30). The counts in the years 1912 and 1913 were made under G. A. Clark; those in 1914 under a group of six investigators, B. W. Harmon, T. Kitahara, J. M. Macoun, W. H. Osgood, G. H. Parker, and E. A. Preble; and those of 1915, 1916, and 1917 under G. D. Hanna.

Table 1 opens with an enumeration of the new-born pups for the seasons under consideration. From 1912 to 1916 inclusive these enumerations were made as direct counts of the numbers of pups on the beaches by methods well established on the islands. In 1916, owing to the increase in the number of pups, direct counting was accomplished only with difficulty, and in 1917, in consequence of still greater increases, it was found necessary to resort in part to a method of estimates. Hence it is believed that the numbers for 1916 and particularly for 1917 are not so accurate as those for the preceding years.

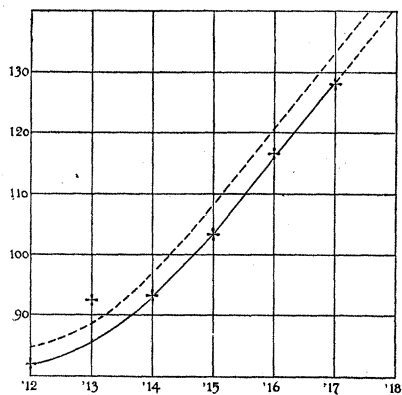
In no feature is the growth of the herd indicated more clearly than in the yearly increase in pups. This increase ranges in a progressive series from 81,984 in 1912 to 128,024 in 1917. The nature of this increase can be appreciated best when the numbers are plotted in some such way as in Graph 1 in which the abscissas represent years and the ordinates numbers of pups in

TABLE 1
NUMERICAL STATEMENT OF THE CONDITION OF THE ALASKAN FUR SEAL HERD FROM 1912
TO 1917 INCLUSIVE

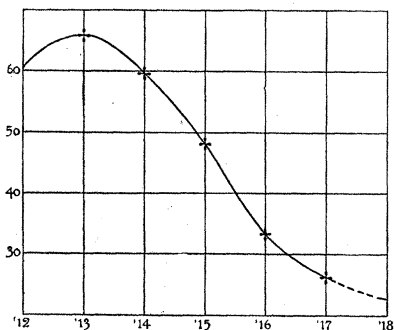
| YEAR | PUPS | HAREM BULLS | AVERAGE HAREM | IDLE BULLS | ESTIMATED TOTAL HERD |
|------|---------|-------------|---------------|------------|-------------------------|
| 1912 | 81,984 | 1,358 | 60.4 | 113 | 215,738 |
| 1913 | 92,269 | 1,403 | 65.8 | 105 | 268,305 |
| 1914 | 93,250 | 1,559 | 59.8 | 172 | 294,687 |
| 1915 | 103,527 | 2,151 | 48.1 | 673 | 363,872 |
| 1916 | 116,977 | 3,500 | 33.4 | 2,632 | 417,281 |
| 1917 | 128,024 | 4,850 | 26.4 | 11,683 | 468,692 |

thousands. Here it will be seen that the successive counts, with the exception of one, lie almost exactly on a curve such as would describe the commencement of an autocatalytic process. This type of curve when complete shows in the beginning an accelerated increase, after which it approximates more nearly to a uniform rate till a decline of this rate sets in due to a checking of autocatalysis by retarding factors. The decline ceases when autocatalysis is balanced by the conditions unfavorable to it. This form of curve is usually applied to the growth of an individual, but there is no reason why it should not apply also to the growth of a population, which after all is protoplasmic growth and hence dependent upon autocatalysis. It is, therefore, not surprising to find that the increase in pups should follow a curve characteristic of such a process. The period of accelerated increase, as Graph 1 shows, extended from 1912 to 1914 or 1915. The period over which a more nearly uniform rate of increase was maintained began in 1914 or 1915 and extended to the last reported count, 1917. How much longer it will continue cannot be stated. Eventually, as numbers augment, the beaches on which the breeding occurs will become overcrowded, shortage of food may supervene, epidemics due to unfavorable conditions may appear, and these and other like influences will cut down the rate of increase until the herd, having arrived at its maximum number, will stand at a constant level. Just as it is impossible to predict how long after 1917 the steady increase will be maintained, so also it is impossible to foretell when equilibrium will be reached.

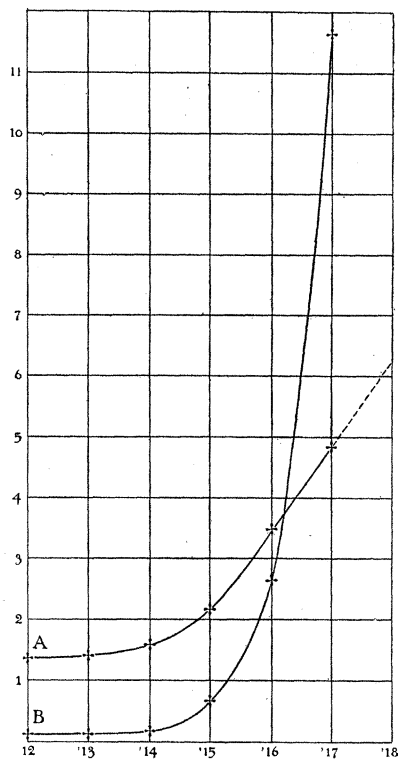
The only pup count that fails to fall in line with the interpretation of the growth of the herd just given is that of 1913. This count when considered in relation to the other counts is some six thousands too high. When the pup census of 1914 was made public, it was pointed out (Osgood, Preble, and Parker, 1915, p. 41) that the increase of this year over the preceding one was very slight, as a matter of fact only a little over 1%, whereas the increase of 1913 over 1912 had been 12.5%. Clark (1916, p. 608) also commented critically on these numbers and stated that "The results gave a gain of only 1%, without any adequate explanation for the irregularity," the implication being that the count of 1914 was deficient. Now that there are in all six counts that may be compared, it is quite obvious, as an inspection of Graph



GRAPH 1



GRAPH 3



GRAPH 2

GRAPH 1. ALASKAN FUR SEAL PUPS BORN IN THE SEASONS 1912 TO 1917 INCLUSIVE

The abscissas represent years and the ordinates numbers of pups in thousands (table 1). The actual numbers counted, except those for the year 1913, fall on a curve represented by the full line which has been extended one year by extrapolation. All counts on the curve are probably low, the dotted curve indicating the direction of their real values.

GRAPH 2. NUMBERS OF HAREM BULLS (A) AND OF IDLE BULLS (B) IN THE ALASKAN FUR SEAL HERD OF THE SEASONS 1912 TO 1917 INCLUSIVE

The abscissas represent years, the ordinates numbers of bulls in thousands (table 1). The curve for harem bulls (A) is extended one year by extrapolation.

GRAPH 3. THE AVERAGE HAREM IN THE ALASKAN FUR SEAL HERD OF THE SEASONS 1912 TO 1917 INCLUSIVE

The abscissas represent years, the ordinates numbers of females in the average harem. The curve has been extended one year by extrapolation.

1 shows, that it is not the count of 1914 that is anomalous but that of 1913. Why this should be so extraordinarily high is difficult to state. It is perfectly clear to any one who has counted pups on the rookeries of the Pribilofs that even the most accurate count is bound to fall short of the real number, so that the magnitudes indicated by the dotted line between 1912 and 1917 in Graph 1 show the directions in which the real numbers lie rather than the solid line of actual enumerations. But even admitting that all the enumerations, except that of 1913, are low, there is no reason to suppose that these are so far low as would be implied on the assumption that the count of 1913 is the most nearly accurate count of them all. It seems impossible that Clark should have improved his method so much between 1912 and 1913 as to have found as large an increase as is implied in the count of 1913. Such increases based on assumed improvement in method do not appear among the several counts by Hanna. But in whatever way this discrepancy in the counts may be explained, it must at least now be clear that the count of 1914 agrees well with the majority of the other enumerations and that the count that is exceptional is that of 1913.

Another way of indicating the growth of the herd as seen in the numbers of pups, is the percentage of annual increase in this constituent. From time to time statements have been made as to what this percentage under normal conditions should be. Thus Clark (1917, p. 499), selecting the increase in 1913 (12.5%) and in 1916 (13.0%), concluded that these figures "may be taken as fixing with reasonable exactness the rate of growth at about 13%." Hanna (Bower and Allen, 1917, p. 92) has expressed the opinion that about 12% is the normal rate of increase. How these numbers compare with the actual figures of the last five years can be seen in table 2.

TABLE 2
INCREASE OF PUPS IN THE ALASKAN FUR SEAL HERD FROM 1913 TO 1917 INCLUSIVE

| YEAR | NUMBER OF PUPS IN THE | | ACTUAL INCREASE | PERCENTAGE INCREASE |
|----------------------|-----------------------|----------------|-----------------|---------------------|
| | GIVEN YEAR | PRECEDING YEAR | | |
| 1913 | 92,269 | — 81,984 | =10,285 | 12.5+ |
| 1914 | 93,250 | — 92,269 | = 981 | 1.1— |
| 1915 | 103,527 | — 93,250 | =10,277 | 11.0+ |
| 1916 | 116,977 | —103,527 | =13,450 | 13.0— |
| 1917 | 128,024 | —116,977 | =11,047 | 9.4+ |
| General average..... | | | | 9.4 |

Here it will be noted that the percentage increase varies from 1.1 to 13.0 with an average of 9.4. This computation included the very anomalous count of 1913, but even if this were replaced by a number such as would be indicated by Graph 1 (86,000) such a replacement would not materially alter the general average. The percentage increase in 1913 would then be 4.9

instead of 12.5 and in 1914, 7.8 instead of 1.1 and the general average would be 9.2 instead of 9.4. Thus for the last five years the annual increase of pups has averaged a little over 9% and is probably nearer 9.5 than 9. Hence both Clark's figures and Hanna's are obviously too high for the present state of the herd. In fact Clark's assumption of 13% is quite unwarranted for he gives no reason for accepting this number rather than the other chosen by him, 12.5.

The average rate of increase indicated in table 2, 9.4%, would bring about a doubling of the number of pups in approximately eight years. If no untoward conditions arise, it is fair to expect that in 1920 about twice as many pups will be born as were born in 1912.

Beside the annual increase in the number of pups born, the Alaskan fur seal herd has given evidence of growth in the increase of its harem bulls. These bulls, which are the sexually mature males that have succeeded in having associated with them one or more breeding females, are perhaps the most accurately counted element in the whole herd. The determination of their numbers between 1912 and 1917 was made by direct count. The results of this census are given in the column in table 1 marked 'harem bulls' where it will be seen that they represent an increasing series running from 1358 in 1912 to 4850 in 1917. The distribution of their rates of increase describes a curve (Graph 2, A) not unlike that seen for the pups. An extrapolation on the basis of this curve leads to the prediction that the number of harem bulls in 1918 will be somewhat over 6000.

The average harem for a given season is the average number of females associated with the harem bull of that season. It is a derived number found by dividing the number of females as indicated by their pups for a given season by the number of harem bulls for that season (table 1). If the males of the herd have been considerably reduced in numbers, as might result from excessive killing, the number in proportion to that of the females would be naturally small and consequently the average harem would be large.

Such a condition, if excessive, would be an unfavorable sign in the herd and improvement would be marked by a decrease in the size of the average harem. The course of events in this particular between 1912 and 1917 is represented in table 1 the details of which can be better appreciated by reference to Graph 3. In this it will be seen that the average harem presented its most unfavorable condition in 1913 after which there was a steady improvement to 1917 in that the average number of females to each harem bull fell from 65.8 to 26.4. It is to be remembered, however, that the extremely unfavorable point in the curve, 1913, is dependent upon the anomalous pup count of that year. Had this count been in line with the others, the average harem for 1913 would have been very near those of 1912 and 1914. The subsequent change, however, would not have been affected and this reduction can not be looked upon as anything but a favorable sign. From the extrapolation in Graph 3, there is good reason to believe that the average harem will be even smaller in 1918 than it was in 1917.

The idle bulls, to turn to another element in the herd, are those males that have attained breeding age but that have failed to obtain one or more females. They usually occupy less favorable areas on the outskirts of the rookeries and may even move from place to place. They can be counted with almost as much accuracy as the harem bulls, but their occasional migrations make their count somewhat uncertain. In 1917 the idle bulls were so numerous that it was deemed wise to subdivide them into two classes, idle bulls proper or those with fixed positions on the breeding grounds but without females, and surplus bulls or those that were unable to find positions on the breeding ground and that usually resorted to other parts of the beaches notably the bachelors' hauling grounds. These two classes are combined in table 1, 1917, under the single head 'idle bulls.'

The idle bull indicates a maladjustment in the breeding conditions of the fur seal. This feature has already been pointed out as evidence of imperfect adaptation in this species (Parker, 1915). As already stated, in the fur seal, as in most other higher animals, the numbers of males and females at birth are very nearly equal. When the breeding period arrives, however, one male associates himself with a large number of females, the lowest average harem in the last five years being over 26 females to one male. Consequently, notwithstanding the fact that the male breeding period is only six to eight years (Clark, 1916, p. 608) as contrasted with the longer female period of approximately ten or eleven years, many males do not procure females. Thus the idle bulls are a measure of this natural maladjustment within the herd. In a wholly natural state of the herd they would undoubtedly be represented by considerable numbers. Their presence, at least in large numbers, can never be anything but a detriment. They are continually stirring up strife not only among themselves but also among the breeding bulls and they are accountable for the maiming and the death of many young seals. They are the individuals that in the period of their best pilage should have been killed for their skins and their excessive numbers indicate poor management of the herd. Their history during the period under consideration is shown in table 1 and more strikingly in Graph 2, B. Here it will be seen that the numbers of idle bulls remained small from 1912 to 1915 after which it increased considerably in 1916 and enormously in 1917.

This constitutes the one unfavorable feature in the recuperation of the herd, for it marks the effective appearance on the beaches of the first real element that is detrimental. Fortunately it is within reasonably easy control, for the fur seal herd is open to the same kind of management that chickens or cattle are. In these stocks, as in the fur seals, the sexes are approximately equal at birth and in both instances, although good management calls for a careful rearing and preservation of females, it also demands the retention of only such males as are necessary for breeding, the excess being drawn off for market purposes. This is clearly what should be done with the surplus male seals, a step that our government is now prepared to take (Smith, 1917, p. 92).

It is only to be regretted that this step was not taken earlier, for the large number of idle bulls now in the herd is both a detriment to that body and a positive loss of once good skins. This menace in the growth of the herd has been repeatedly pointed out (Clark, 1914, 1916, 1917; Osgood, Preble, and Parker, 1915) to those having the matter in charge.

The last column in table 1 contains the estimated annual totals for the herd. These numbers are highly artificial in that they are largely made up of computed elements and they are, therefore, so remote from direct observation that their detailed consideration is scarcely worth while. The fact that all elements of the herd have separately increased between 1912 and 1917 is reflected in the increase of these calculated totals from 215,738 in 1912 to 468,692 in 1917.

In conclusion it may be stated that since 1912 the steady increase in the numbers of pups born, and of harem bulls and the decrease since 1913 of the average harem are most favorable signs in the growth of the herd. The one unfavorable feature during this period is the considerable increase in idle bulls in 1915, 1916, and especially in 1917. This increase, which can be eventually checked, shows that active commercial killing should have been restored some years ago.

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THE DESTRUCTION OF TETANUS ANTITOXIN BY CHEMICAL AGENTS

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Communicated by R. Pearl, April 13, 1918

The ultimate object of this work is a solution of the problem of the chemical nature of antitoxins and their preparation in the pure state. That this would be attained was not expected in view of the numerous previous investigations which left these problems unsolved. But it seemed highly probable that data would be obtained which would throw some light on the subject.

Up to the present time numerous investigators attempted to separate antitoxins from their associated proteins, but without complete success. The